

Preliminary Checklist of Marine Gastropods and Bivalves in the Kalayaan Island Group Palawan, Western Philippines*

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ABSTRACT

The Kalayaan Island Group (KIG) in the West Philippine Sea is a threatened rich fishing ground endowed with diverse flora and fauna. However, studies about gastropods and bivalves in KIG are lacking. This preliminary listing of shelled gastropods and bivalves of KIG is based on collections in 2014 and 2016. Seventy eight species of shelled gastropod and bivalves belonging to 28 families were documented. The list includes some threatened species of giant clams and large reef gastropods. Extensive sampling especially in deep areas is expected to enrich the current list. Species inventory of other taxa is also suggested to understand the extent of biological diversity in this wide eco-region.

INTRODUCTION

The Kalayaan Island Group (KIG) is a 5th class municipality in the Province of Palawan, Philippines. Located in the West Philippine Sea, KIG is composed of seven islands and one reef with an aggregate land area of approximately 79 ha, and covers an approximate area of 168,287.07 km². Among the seven islands, Pag-asa is the largest and the only civilian-inhabited island. The KIG as part of the contested Spratly Islands in the South China Sea with various claimant countries is thought to have rich oil deposits aside from being a rich fishing ground (McManus 1992, 1994, in press, Christensen et al. 2003, Palatino 2008, Gomez 2011, Owen and Schofield 2012).

Shelled gastropods and bivalves are of economic importance (Carpenter and Niem 1998, Floren 2003). They are heavily harvested as food, and the shells are utilized in a wide array of handicrafts. Rare and beautiful species of cowries (e.g. *Lyncina aurantium*) and cone snails (e.g. *Conus gloriamaris*) are highly prized collector's items (Floren 2003). The vast seas and extensive reefs in South China Sea is home to a great diversity of species and is an important fishing ground

(McManus 1994, in press, Christensen et al. 2003, Mora et al. 2016) yet studies about the terrestrial and marine biological diversity in KIG is limited. Only Gonzales (2008) has reported the status of corals and reef associated fauna of Pag-asa Island and adjacent areas. This paper aims to provide a preliminary checklist of marine shelled gastropods and bivalves as part of a bigger effort to assess the marine resources in KIG.

MATERIALS AND METHODS

The study was conducted in KIG which lies about 480 km (300 mi) west of Palawan (Figure 1). Sampling was conducted on April 28 – May 5, 2014 and May 1 – 8, 2016. In 2014, the specimens were obtained by reef walking or gleaning at intertidal areas for about one hour during day low tide in the following islands: Pag-asa Island (Thitu Is), Likas Island (West York Island), Parola Island (northeast cay), Kota Island (Loita Is), Panata Island, (Lankiam) Lawak Island (Nanshan Is), Patag Island (Flat Is). In 2016, sampling was only conducted at the intertidal area of Pag-asa Island. Some empty shells found on the beach were also collected. The samples are deposited at Western Philippines University (WPU) Museum. Species were photo documented and identified based on shell morphology using the works of Springsteen and Leobrera (1986), Abott and Dance (2000), and Laureta (2008). The species taxonomy is verified from World Register of Marine Species (WoRMS 2016).

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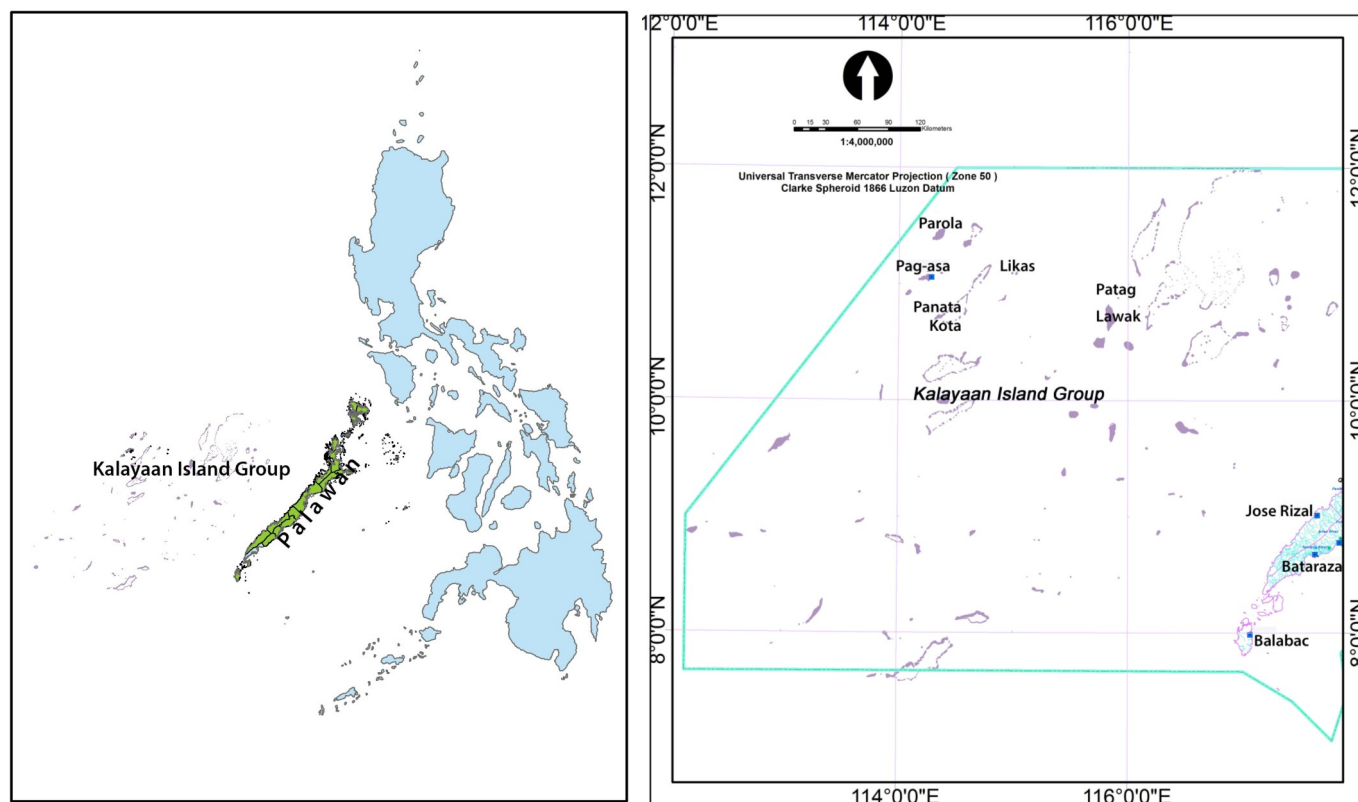


Figure 1. The map of the Philippines indicating the location of Kalayaan Island Group (left) and the location of seven sampling sites within KIG (right).

RESULTS AND DISCUSSION

Species checklist. A total of 69 shelled gastropods belonging to 26 families (Table 1, Figures 2-4) and nine bivalves belonging to five families (Table 2, Figure 5) were recorded.

The numbers of species of gastropods and bivalves in this study are comparable to other localities (Table 3). There could be variations on the similarities of species especially across wide regions but the numbers of reported species provide information on how much species a locality can support. An archipelagic country like the Philippines is known for more than 1,600 species of gastropods and bivalves (Springsteen and Leobrera 1986) and given the vast area of KIG (see McManus 1992, 1994, in press) and its proximity to the Coral Triangle – the global center of marine biodiversity (Asian Development Bank 2014), the current list possibly only comprise a small fraction of the total species richness of shelled gastropods and bivalves in the area. In this study, only five species belong to family Cardiidae were recorded in contrast to 54 species obtained in deep sea expedition from Panglao, Bohol (Ter Poorten 2009). Continued species inventory to include small and deep water inhabiting species is expected to add to the current list.

The list include three Philippine endangered species of bivalves (*Hippopus hippopus*, *Tridacna derasa* and *Tridacna*

squamosa) all under subfamily Tridacninae (giant clams) and one threatened gastropod *Tectus niloticus* (DA 2001). All giant clam species found in the Philippines are also listed in CITES Appendix II (CITES 2016). Species listed in CITES Appendix II are not necessarily threatened with extinction, but may be endangered in the future unless the shell/meat trade is closely controlled. Overharvesting had already resulted to local extinctions of giant clams in Singapore (Neo and Todd 2013) and Fiji (Adams 1988). The updated list of the Palawan Council for Sustainable Development (PCSD) categorized *Tectus niloticus*, and *Charonia tritonis* as Endangered species (PCSD 2010). However, with unregulated harvesting in KIG, not only gastropods and bivalves are on the brink of extinction (Palatino 2008, Gomez 2011, Owen and Schofield 2012, Zambrano 2014, Wingfield-Hayes 2015), but also many other economically important and threatened fish species such as Bumphead Parrot *Bolbometopon muricatum*, sawfishes belonging to the general *Pristis* and *Anoxypristis* (Mora et al. 2016), marine turtles and many other large reef fishes (McManus in press). Aside from continued species inventory, habitat and population assessment of commonly harvested species is needed to find out the true status of these marine resources in KIG.

Table 1. Preliminary list of shelled gastropods collected from Kalayaan Island Group (KIG), Palawan, Philippines.

Family	Scientific names	Family	Scientific names
1. Buccinidae	1. <i>Cantharus wagneri</i> (Anton, 1839)	7. Fasciariidae	29. <i>Peristernia nassatula</i> (Lamarck, 1822)
	2. <i>Polia undosa</i> (Linnaeus, 1758)		30. <i>Peristernia ustulata</i> (Reeve, 1847)
2. Burcidae	3. <i>Bursa granularis</i> (Röding, 1798)	8. Harpidae	31. <i>Pleuroploca trapezium</i> (Linnaeus, 1758)
	4. <i>Cerithium nodulosum</i> (Bruguiere, 1792)		32. <i>Harpa articularis</i> (Lamarck, 1822)
3. Cerithiidae	5. <i>Rhinoclavis articulata</i> (Adams and Reeve, 1850)	9. Haliotidae	33. <i>Haliotis asinina</i> (Linnaeus, 1758)
	6. <i>Rhinoclavis sinensis</i> (Gmelin, 1791)		34. <i>Haliotis planata</i> (G.B Sowerby II, 1822)
	7. <i>Rhinoclavis vertagus</i> (Linnaeus, 1767)	10. Lottiidae	35. <i>Patelloida striata</i> (Qouy and Gaimard, 1834)
	8. <i>Conus distans</i> (Hwass, in Bruguière, 1792)		36. <i>Patelloida saccharinoides</i> (Habe and Kosuge, 1966)
	9. <i>Conus ebraeus</i> (Linnaeus, 1758)	11. Mitridae	37. <i>Mitra papalis</i> (Linnaeus, 1758)
	10. <i>Conus eburneus</i> (Hwass, in Bruguière, 1792)		38. <i>Chicoreus banksii</i> (G. B. Sowerby II, 1841)
4. Conidae	11. <i>Conus leopardus</i> (Röding, 1798)		39. <i>Chicoreus strigatus</i> (Reeve, 1849)
	12. <i>Conus spectrum</i> (Linnaeus, 1758)	12. Muricidae	40. <i>Drupa ricinus</i> (Linnaeus, 1758)
	13. <i>Conus stercusmuscarum</i> (Linnaeus, 1758)		41. <i>Drupa rubusidaeus</i> (Roding, 1798)
	14. <i>Conus thalassiarachus</i> (G. B Sowerby, 1834))		42. <i>Latiaxis morphospecies</i> 1
	15. <i>Conus morphospecies</i> 1		43. <i>Morula uva</i> (Roding, 1798)
	16. <i>Conus morphospecies</i> 2	13. Nassariidae	44. <i>Nassarius distortus</i> (Adams, 1852)
5. Costellariidae	17. <i>Zierliana anthracina</i> (Reeve, 1844)		45. <i>Mammilla melanostoma</i> (Gmelin, 1791)
	18. <i>Cypraea tigris</i> (Linnaeus, 1758)	14. Naticidae	46. <i>Polinices morphospecies</i> 1
	19. <i>Erosaria boivini</i> (Kiener, 1843)		47. <i>Nerita albicilla</i> (Linnaeus, 1758)
	20. <i>Erosaria erosa</i> (Linnaeus, 1758)	15. Neritidae	48. <i>Nerita costata</i> (Gmelin, 1791)
	21. <i>Erosaria helvola</i> (Linnaeus, 1758)		49. <i>Nerita plicata</i> (Linnaeus, 1758)
	22. <i>Leporicypraea mappa</i> (Linnaeus, 1758)	16. Olividae	50. <i>Nerita polita</i> (Linnaeus, 1758)
6. Cypraeidae	23. <i>Lyncina carneola</i> (Linnaeus, 1758)		51. <i>Oliva annulata</i> (Gmelin, 1791)
	24. <i>Mauritia arabica</i> (Linnaeus, 1758)	17. Personidae	52. <i>Distorsio anus</i> (Linnaeus, 1758)
	25. <i>Monetaria annulus</i> (Linnaeus, 1758)		53. <i>Charonia tritonis</i> (Linnaeus, 1758)
	26. <i>Monetaria caputserpentis</i> (Linnaeus, 1758)	18. Ranellidae	54. <i>Monoplex aquatilis</i> (Reeve, 1844)
	27. <i>Monetaria moneta</i> (Linnaeus, 1758)		
	28. <i>Cyprea</i> sp. 1		

Table 3. Species richness of gastropods and bivalves in some areas in Philippines and Asia.

Area	No. of Gastropod species	No. of Bivalve species	Total number of species	Author
Tubbataha Reefs Natural Marine Park, Palawan	79	17	96	Dolorosa et al. (2015)
Binduyan Marine Research Station (BMRS), PPC, Palawan	64	8	72	Hombre (2015)
Binunsalian and Turtle bays, Palawan	89	19	108	Picardal and Dolorosa (2014)
Iwahig River, PPC, Palawan	50	15	75	Dolorosa and Dangan-Galon, (2014)
Malunao and Sobrero, Aborlan, Palawan	46	27	73	Dolorosa and Molleno (2016)
Grande Island, Subic Bay, Philippines	86	14	100	Batomalagu e et al. (2010)
Hadji Panglima Tahil, Province of Sulu, Philippines	15	3	18	Tabugo et al. (2013)
Anambas and Natuna Island, South China Sea	91	43	134	Tan and Kastoro (2004)
Kalayaan Island Group	69	9	78	This study

Cont'd. Table 1.

Family	Scientific names
19. Strombidae	55. <i>Euprotomus aurisdianae</i> (Linnaeus, 1758)
	56. <i>Harpago chiragra</i> (Linnaeus, 1758)
	57. <i>Lambis lambis</i> (Linnaeus, 1758)
	58. <i>Lentigo lentiginosus</i> (Linnaeus, 1758)
20. Tegulidae	59. <i>Tectus niloticus</i> (Linnaeus, 1767)
	60. <i>Trochus stellatus</i> (Gmelin, 1791)
21. Terebridae	61. <i>Oxymoris areolata</i> (Link, 1807)
22. Trochidae	62. <i>Monodonta canalifera</i> (Lamarck, 1816)
23. Tonnidae	63. <i>Malea pomum</i> (Linnaeus, 1758)
	64. <i>Tonna perdx</i> (Linnaeus, 1758)
24. Turbinidae	65. <i>Lunella cinerea</i> (Born, 1778)
	66. <i>Turbo chrysostomus</i> (Linnaeus, 1758)
	67. <i>Turbo petholatus</i> (Linnaeus, 1758)
25. Turridae	68. <i>Turris babylonica</i> (Linnaeus, 1758)
26. Volutidae	69. <i>Cymbiola vespertilio</i> (Linnaeus, 1758)

Table 2. Preliminary list of bivalves collected from Kalayaan Island Group (KIG), Palawan, Philippines.

Family	Scientific names
1. Arcidae	1. <i>Anadara antiquata</i> (Linnaeus, 1758)
	2. <i>Corculum impressum</i> (Lightfoot, 1786)
	3. <i>Fragum unedo</i> (Linnaeus, 1758)
2. Cardiidae	4. <i>Hippopus hippopus</i> (Linnaeus, 1758)
	5. <i>Tridacna maxima</i> (Röding, 1798)
	6. <i>Tridacna squamosa</i> (Lamarck, 1819)
3. Carditidae	7. <i>Cardita variegata</i> (Bruguiere, 1792)
4. Lucinidae	8. <i>Codakia tigrina</i> (Linnaeus, 1758)
5. Veneridae	9. <i>Circe scripta</i> (Linnaeus, 1758)



Figure 2. The gastropods of Kalayaan Island Group: a) *Cantharus wagneri*, 31.2 mm; b) *Pollia undosa*, 31.1 mm; c) *Bursa granularis*, 36.6 mm; d) *Cerithium nodulosum*, 55 mm; e) *Rhinoclavis articulata*, 19 mm; f) *Rhinoclavis sinensis*, 19 mm; g) *Rhinoclavis vertagus*, 46.4 mm; h) *Conus distans*, 54.2 mm; i) *Conus ebraeus*, 20.1 mm; j) *Conus eburneus*, 35 mm; k) *Conus leopardus*, 89.4 mm; l) *Conus spectrum*, 46.9 mm; m) *Conus stercusmuscarum*, 40.3 mm; n) *Conus thalassiarthus*, 44.2 mm; o) *Conus* sp. 1, 22 mm; p) *Conus* sp. 2, 20 mm; q) *Zierliana anthracina*, 26.3 mm; r) *Cypraea tigris*, 68.3 mm; s) *Erosaria boivinii*, 42.4 mm; and t) *Erosaria erosa*, 26.6 mm.



Figure 3. The gastropods of Kalayaan Island Group: a) *Erosaria helvola*, 17.1 mm; b) *Leporicypraea mappa*, 43 mm; c) *Lyncina carneola* (faded), 43.3 mm; d) *Mauritia arabica*, 46.1 mm; e) *Monetaria annulus*, 31.1 mm; f) *Monetaria caputserpentis*, 31.2 mm; g) *Monetaria moneta*, 31.2 mm; h) *Cypraea* sp. 1, 30 mm; i) *Peristernia nassatula*, 35 mm; j) *Peristernia ustulata*, 35 mm; k) *Pleuroploca trapezium*, 131.4 mm; l) *Harpa articularis*, 61.1 mm; m) *Haliotis asinina*, 81.2 mm; n) *Haliotis planata*, 79 mm; o) *Patelloida striata*, 25.5 mm; p) *Patelloida saccharinoides*, 24.8 mm; q) *Mitra papalis*, 104.4 mm; r) *Chicoreus banksii*, 50 mm; s) *Chicoreus strigatus*, 50.7 mm; t) *Drupa ricinus*, 21.1 mm; and u) *Drupa rubusidaeus*, 37.2 mm.



Figure 4. The gastropods of Kalayaan Island Group: a) *Latiaxis* sp., 41.5 mm; b) *Morula uva*, 35.3 mm; c) *Nassarius distortus*, 51.8 mm; d) *Mammilla melanostoma*, 18.2 mm; e) *Polinices* sp.1, 18 mm; f) *Nerita albicilla*, 12.3 mm; g) *Nerita costata*, 12 mm; h) *Nerita plicata*, 12.1 mm; i) *Nerita polita*, 11 mm; j) *Oliva annulata*, 36.1 mm; k) *Distorsio anus*, 25.4 mm; l) *Charonia tritonis*, 174.2 mm; m) *Monoplex aquatilis*, 62.4 mm; n) *Euprotomus aurisdianae*, 49.6 mm; o) *Harpago chiragra*, 111.2 mm; p) *Lambis lambis*, 119.2 mm; q) *Lentigo lentiginosus*, 66.4 mm; r) *Tectus niloticus*, 46.6 mm; s) *Trochus stellatus*, 27.1 mm; t) *Oxymyeris areolata*, 70.3 mm; u) *Monodonta canalifera*, 18.3 mm; v) *Malea pomum*, 56 mm; w) *Tonna perdix*, 56.1 mm; x) *Lunella cinerea*, 25.5 mm; y) *Turbo chrysostomus*, 50.3 mm; z) *Turbo petholatus*, 36.1 mm; aa1) *Turris babylonica*, 49.2 mm; aa2) *Turris babylonica* (juvenile), 15 mm; and bb) *Cymbiola vespertilio*, 72.5 mm.

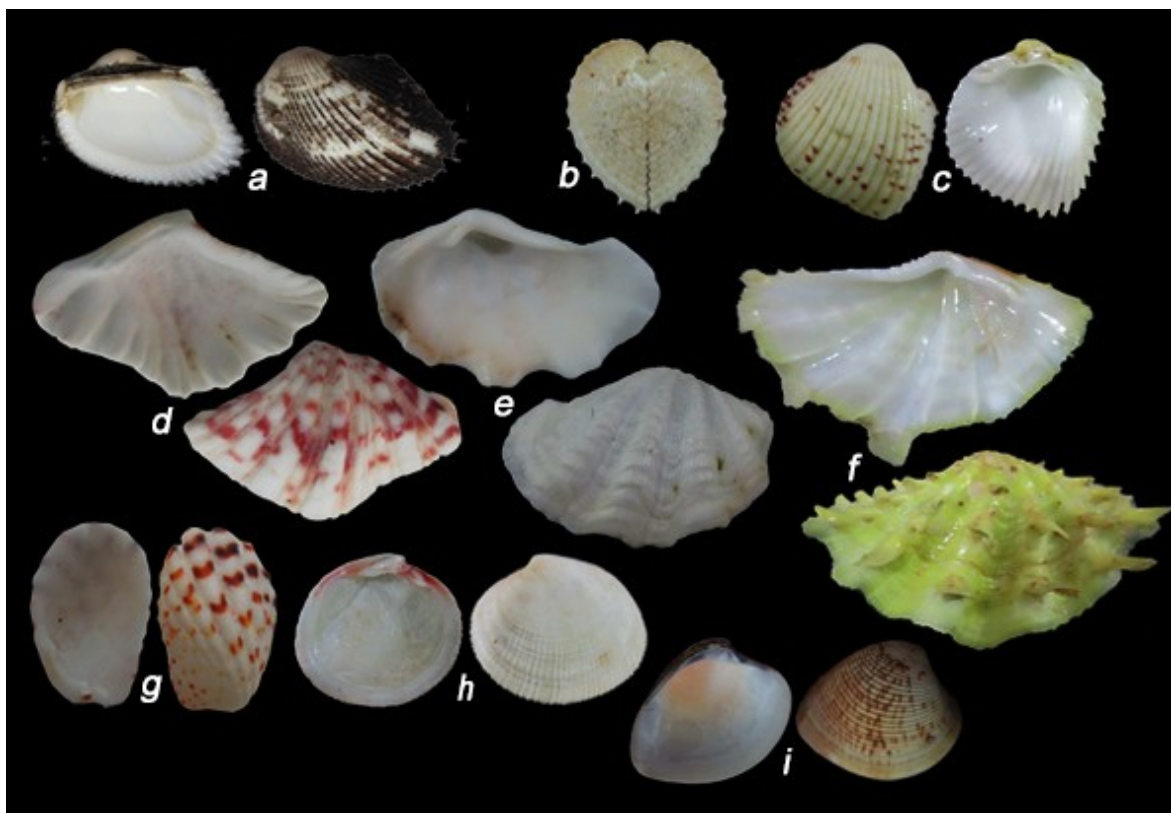


Figure 5. The bivalves of Kalayaan Island Group: a) *Anadara antiquata*, 51.3 mm; b) *Corculum impressum*, 63.4 mm; c) *Fragum unedo*, 30.9 mm; d) *Hippopus hippopus*, 61.4 mm; e) *Tridacna maxima*, 25.5 mm; f) *Tridacna squamosa*, 26 mm; g) *Cardita variegata*, 38.2 mm; h) *Codakia tigerina* 38.1 mm; and i) *Circe scripta*, 46.1mm.

CONCLUSION AND RECOMMENDATIONS

The present study listed 78 species of shelled gastropods and bivalves in KIG and this may increase with continued survey especially in the deeper waters. The meat of most of these species is valued as food and most if not all of the shells are used in handicraft/shell craft industry. Five endangered species (three bivalves and two gastropods) were recorded in the area. Further study is recommended to enrich this list.

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